

An analysis is presented of perinatal and neonatal losses by gestation, birth weight, and ethnic group among almost 650,000 deliveries in New York City from 1958 to 1961. The patterns of loss among whites and nonwhites are discussed in terms of differences and similarities. Research is needed to determine whether there is a difference in the rates of development of fetuses of different ethnic groups.

INFLUENCE OF WEIGHT AND GESTATION ON PERINATAL AND NEONATAL MORTALITY BY ETHNIC GROUP

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BECAUSE of the recognized uncertainty of duration of gestation the objective measure of weight at birth has been widely used as an indicator of maturity of an infant at delivery. Yet, there is no question that, for any specific weight, the probability of survival will be closely related to the duration of pregnancy.^{1,2} Moreover, infant mortality among nonwhites at low birth weight has been widely noted to be less than that among whites, whereas at weights above 2,500 grams the rate among whites is lower. This reversal in relative mortality by weight at birth has led to the hypothesis that nonwhite infants at lower weights are more mature than white infants. In addition to other observations, we shall look into this hypothesis, at least insofar as maturity is measured by duration of gestation.

Source of Data

For this analysis we have accumulated four years experience among single-born deliveries at 20 or more weeks gestation,

representing 655,542 live births and 16,373 fetal deaths, as reported on certificates filed with the New York City Department of Health in 1958 through 1961. From the total 671,915 deliveries, 24,054 (3.6 per cent) were excluded because information on weight, gestation, or both was not reported, leaving 647,861 deliveries available for analysis. Of these, 513,197 were white and 134,664 nonwhite. Analysis had to be restricted to the weight and gestation intervals available in the data already tabulated. The numeric distributions by weight and gestation for the total deliveries are given in Table 1 for each ethnic group.

Limitations of Data

Among the total reported pregnancies, both weight and gestation were unknown for about one in 1,000 cases among whites and two in 1,000 among nonwhites; weight alone was not reported by 1.2 and 2.0 per cent respectively, and gestation alone for 1.9 and 3.1 per cent respectively. Contrary to the im-

Table 1.—Distribution of Single Pregnancies by Birth Weight, by Duration of Pregnancy and by Ethnic Groups—New York City, 1958-1961

| Birth Weight (grams) | Duration of Pregnancy (Weeks) | | | | | | | | | | | Total | |
|-------------------------|-------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|--------|---------|---------|----------------|
| | 20-25 | 26-27 | 28-29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37-39 | | 40 and Over |
| White | | | | | | | | | | | | | |
| Under 1,001 | 2,028 | 646 | 398 | 152 | 113 | 90 | 72 | 72 | 43 | 34 | 86 | 67 | 3,801 |
| 1,001-1,500 | 200 | 312 | 648 | 300 | 189 | 180 | 169 | 129 | 111 | 112 | 209 | 111 | 2,670 |
| 1,501-2,000 | 83 | 124 | 267 | 329 | 513 | 639 | 595 | 486 | 498 | 453 | 1,217 | 581 | 5,785 |
| 2,001-2,500 | 65 | 73 | 220 | 200 | 285 | 564 | 1,031 | 1,601 | 1,988 | 2,588 | 11,207 | 5,824 | 25,646 |
| 2,501-3,000 | 78 | 82 | 216 | 258 | 329 | 535 | 907 | 1,684 | 3,061 | 5,746 | 56,363 | 42,716 | 111,975 |
| 3,001-3,500 | 82 | 106 | 177 | 245 | 331 | 483 | 887 | 1,491 | 2,678 | 4,697 | 89,788 | 108,647 | 209,612 |
| 3,501-4,000 | 44 | 39 | 69 | 99 | 115 | 155 | 267 | 533 | 1,099 | 1,815 | 39,002 | 77,842 | 121,079 |
| 4,001-4,500 | 9 | 4 | 9 | 14 | 29 | 34 | 40 | 87 | 184 | 376 | 6,732 | 20,283 | 27,801 |
| 4,501-5,000 | 1 | — | 1 | — | 2 | 6 | 6 | 14 | 23 | 47 | 827 | 3,354 | 4,281 |
| 5,001 and over | 2 | — | — | — | 2 | 3 | 1 | 2 | 6 | 13 | 122 | 396 | 547 |
| Total | 2,592 | 1,386 | 2,005 | 1,597 | 1,908 | 2,689 | 3,975 | 6,099 | 9,691 | 15,881 | 205,553 | 259,821 | 513,197 |
| Nonwhite | | | | | | | | | | | | | |
| Under 1,001 | 1,484 | 397 | 233 | 72 | 55 | 33 | 31 | 41 | 17 | 14 | 55 | 43 | 2,475 |
| 1,001-1,500 | 211 | 245 | 403 | 220 | 168 | 130 | 102 | 88 | 62 | 43 | 106 | 54 | 1,832 |
| 1,501-2,000 | 120 | 124 | 247 | 214 | 338 | 407 | 425 | 334 | 288 | 263 | 568 | 268 | 3,596 |
| 2,001-2,500 | 83 | 95 | 185 | 186 | 233 | 351 | 583 | 841 | 1,121 | 1,408 | 4,621 | 2,323 | 12,030 |
| 2,501-3,000 | 98 | 91 | 216 | 183 | 275 | 415 | 648 | 1,005 | 1,536 | 2,559 | 18,397 | 12,242 | 37,665 |
| 3,001-3,500 | 74 | 61 | 124 | 145 | 185 | 319 | 499 | 857 | 1,357 | 2,009 | 22,509 | 22,536 | 50,675 |
| 3,501-4,000 | 22 | 23 | 38 | 33 | 53 | 84 | 125 | 264 | 438 | 692 | 7,945 | 11,968 | 21,685 |
| 4,001-4,500 | 3 | 5 | 3 | 7 | 12 | 12 | 21 | 42 | 64 | 97 | 1,167 | 2,541 | 3,974 |
| 4,501-5,000 | 1 | — | 1 | — | 1 | 4 | 2 | 3 | 14 | 18 | 157 | 418 | 619 |
| 5,001 and over | — | — | — | — | — | — | 1 | — | 1 | 6 | 26 | 79 | 113 |
| Total | 2,096 | 1,041 | 1,450 | 1,060 | 1,320 | 1,755 | 2,437 | 3,475 | 4,898 | 7,109 | 55,551 | 52,472 | 134,664 |

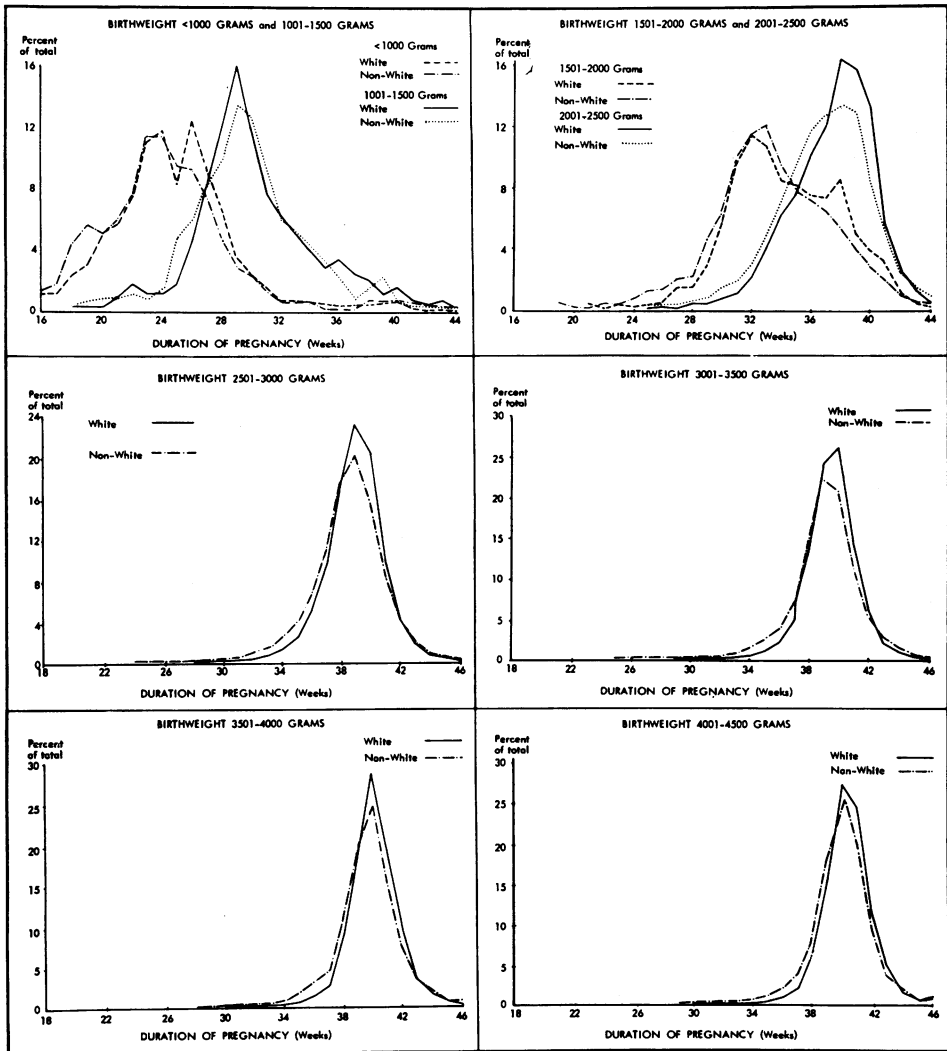
Note: Pregnancies terminating before 20 weeks or with unknown birth weight and/or duration of pregnancy are excluded from this table.

plication of these figures, smaller proportions with weight not reported were found among nonwhite deliveries at each gestation interval. As expected, the maximum percentages with weight not reported occurred in the groups less than 26 weeks gestation with 50 per cent not

reported among whites and 40 per cent among nonwhites. These proportions diminished rapidly to less than one per cent for deliveries at 36 weeks or more.

On the other hand, failure to report information allowing calculation of the gestation interval was uniformly more

Figure 1—Estimated Percentage Distributions of Single Live Births by Duration of Pregnancy and by Ethnic Groups for Specific Birth Weight Groups: New York City, 1958-1961



NOTE: Individual weeks <30 and 37 and over estimated from Jan.-Nov. 1962 births.

Table 2—Perinatal Mortality Rates for Single Deliveries by Birth Weight, by Duration of Pregnancy and by Ethnic Groups—New York City, 1958-1961

| Birth Weight (grams) | Duration of Pregnancy (Weeks) | | | | | | | | | | | | Total |
|-------------------------|-------------------------------|-------|-------|-------|-------|--------|-------|-------|-------|--------|-------|----------------|-------|
| | 20-25 | 26-27 | 28-29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37-39 | 40 and Over | |
| White | | | | | | | | | | | | | |
| Under 1,001 | 989.6 | 936.5 | 899.5 | 921.1 | 955.8 | 988.9 | 944.4 | 986.1 | 930.2 | 970.6 | 860.5 | 761.2 | 958.7 |
| 1,001-1,500 | 750.0 | 756.4 | 612.7 | 503.3 | 545.0 | 583.3 | 668.6 | 612.4 | 648.6 | 580.4 | 641.1 | 540.5 | 623.6 |
| 1,501-2,000 | 445.8 | 338.7 | 445.7 | 431.6 | 366.5 | 273.9 | 245.4 | 247.0 | 249.0 | 236.2 | 226.0 | 290.9 | 284.2 |
| 2,001-2,500 | 338.5 | 123.3 | 181.8 | 150.0 | 175.4 | 166.7 | 117.4 | 86.2 | 74.4 | 62.2 | 44.5 | 54.3 | 63.5 |
| 2,501-3,000 | 128.2 | 36.6 | 50.9 | 50.4 | 54.7 | 54.2 | 45.2 | 37.4 | 35.6 | 24.4 | 10.9 | 14.4 | 14.9 |
| 3,001-3,500 | 61.0 | 47.2 | 45.2 | 16.3 | 24.2 | 33.1 | 21.4 | 18.8 | 15.3 | 13.8 | 6.3 | 7.6 | 7.6 |
| 3,501-4,000 | 45.5 | 179.5 | 14.5 | 30.3 | 26.1 | 6.5 | 22.5 | 22.5 | 24.6 | 17.1 | 6.5 | 7.4 | 7.6 |
| 4,001-4,500 | 0.0 | 0 | 111.1 | 0 | 69.0 | 29.4 | 0 | 69.0 | 27.2 | 34.6 | 13.2 | 9.1 | 10.9 |
| 4,501-5,000 | 0 | 0 | 0 | 0 | 0 | 166.7 | 166.7 | 142.9 | 174.0 | 63.8 | 45.9 | 15.2 | 23.4 |
| 5,001 and over | 500.0 | 0 | 0 | 0 | 500.0 | 1000.0 | 0 | 0 | 166.7 | 76.9 | 131.1 | 78.3 | 98.7 |
| Total | 861.9 | 654.4 | 466.3 | 302.4 | 252.1 | 191.1 | 129.6 | 85.1 | 58.9 | 39.0 | 12.5 | 11.1 | 25.8 |
| Nonwhite | | | | | | | | | | | | | |
| Under 1,001 | 956.9 | 881.6 | 871.2 | 861.1 | 836.4 | 878.8 | 871.0 | 853.7 | 823.5 | 1000.0 | 818.2 | 767.4 | 920.4 |
| 1,001-1,500 | 663.5 | 579.6 | 513.6 | 372.7 | 416.7 | 561.5 | 402.0 | 420.5 | 371.0 | 325.6 | 537.7 | 463.0 | 497.3 |
| 1,501-2,000 | 333.3 | 241.9 | 251.0 | 247.7 | 213.0 | 167.1 | 176.5 | 149.7 | 173.6 | 178.7 | 153.2 | 223.9 | 193.0 |
| 2,001-2,500 | 168.7 | 94.7 | 113.5 | 91.4 | 64.4 | 51.3 | 56.6 | 65.4 | 50.8 | 47.6 | 36.6 | 45.2 | 48.2 |
| 2,501-3,000 | 20.4 | 11.0 | 32.4 | 21.9 | 21.8 | 24.1 | 34.0 | 20.9 | 17.0 | 21.9 | 10.1 | 16.6 | 14.4 |
| 3,001-3,500 | 67.6 | 32.8 | 16.1 | 20.7 | 27.0 | 18.8 | 10.0 | 12.8 | 12.5 | 10.0 | 8.6 | 9.5 | 10.0 |
| 3,501-4,000 | 90.9 | 0 | 0 | 30.3 | 0 | 23.8 | 0 | 0 | 20.5 | 23.1 | 8.4 | 12.1 | 11.2 |
| 4,001-4,500 | 0 | 200.0 | 333.3 | 142.9 | 83.3 | 83.3 | 47.6 | 23.8 | 15.6 | 72.2 | 20.6 | 21.6 | 23.7 |
| 4,501-5,000 | 1000.0 | 0 | 0 | 0 | 0 | 0 | 500.0 | 0 | 142.9 | 222.2 | 44.6 | 31.1 | 45.2 |
| 5,001 and over | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 166.7 | 76.9 | 240.5 | 194.7 |
| Total | 774.8 | 513.9 | 346.9 | 210.4 | 162.9 | 117.9 | 84.1 | 60.4 | 40.6 | 34.6 | 15.1 | 16.6 | 43.6 |

Note: Perinatal mortality rate=Number of perinatal deaths (fetal and neonatal) per 1,000 deliveries.

frequent among the nonwhites, but the proportions were much smaller than for unreported weights. The range was from 3.9 per cent (whites) and 6.8 per cent (nonwhites) at weights less than 1,000 grams to 1.6 and 2.7 per cent respectively at 4,001-4,500 grams.

The major contribution to these proportions of unknowns, particularly for weight, is made by fetal deaths, since the corresponding proportions for live births alone at less than 26 weeks gestation are but 9.8 and 5.5 per cent for whites and nonwhites, respectively (com-

Figure 2—Perinatal and Neonatal Mortality Rates Among Single Deliveries by Duration of Pregnancy and by Ethnic Groups: New York City, 1958-1961

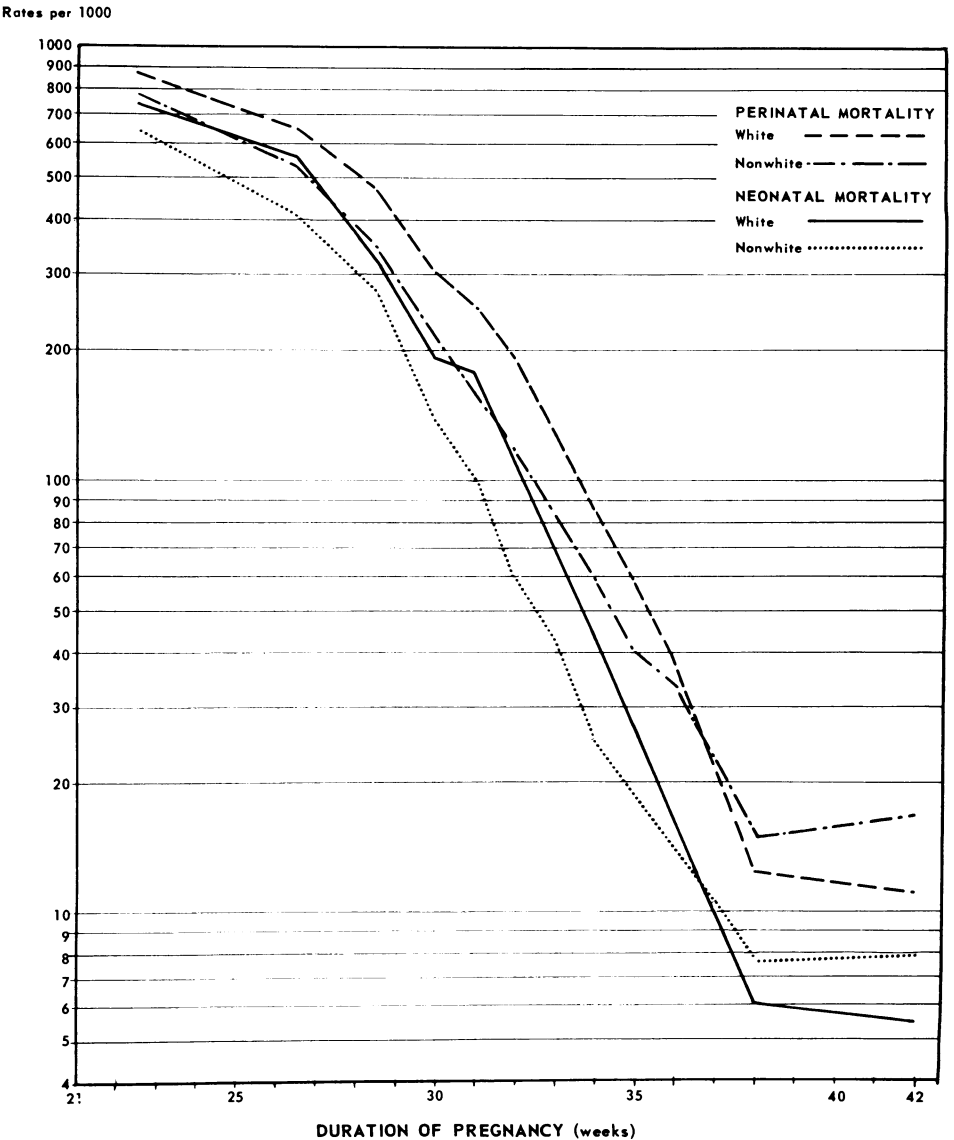
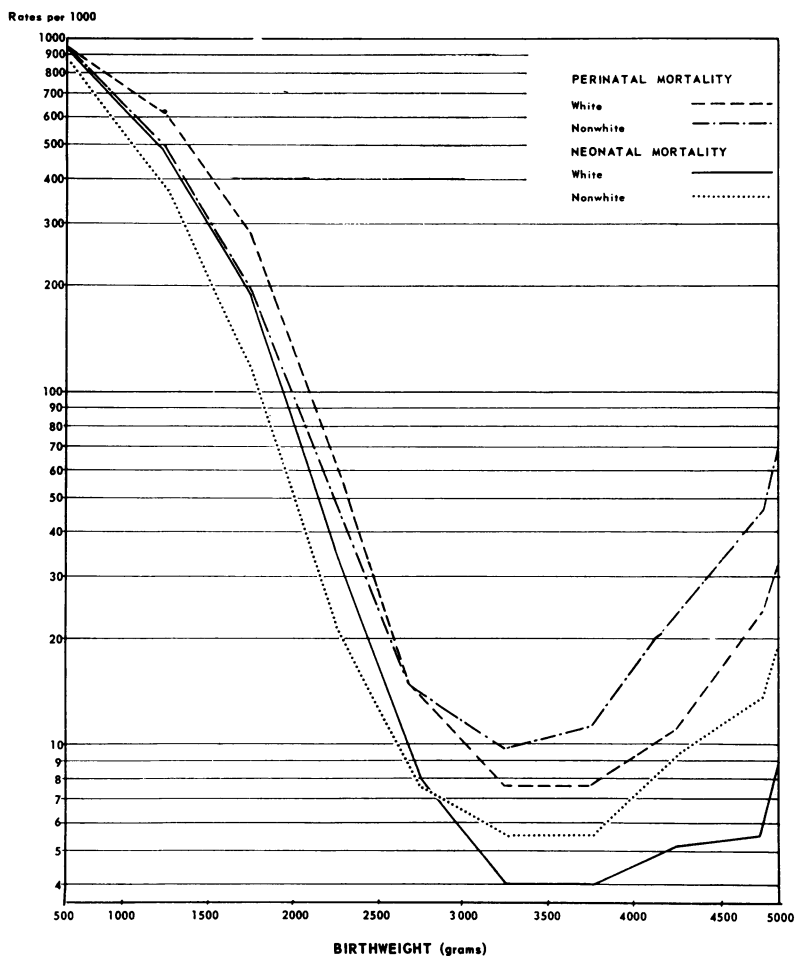


Figure 3—Perinatal and Neonatal Mortality Rates Among Single Deliveries by Birth Weight and by Ethnic Groups: New York City, 1958-1961



pared to the 50 and 40 per cent for total pregnancies). Among live births at 26-27 weeks gestation, the proportions of unknown weight drop to 4.7 and 3.5 per cent and diminish further thereafter. The lower proportions for live births are largely accounted for by a campaign extending over many years to get birth weight information for live born infants; in addition there is a disinclination on the part of hospital personnel to weigh fetuses born dead.

One major objection to using birth record data for gestation has been the

demonstrated error that occurs when this item is reported in completed weeks of gestation.^{1,3} For this reason, the New York City certificates have, since January 1, 1957, required the initial date of the last menstrual period. Duration of pregnancy in this paper is that calculated from this date and the reported date of delivery. Improvements in the resulting gestation distributions were evident in that the proportion of live deliveries at exactly 40 weeks was reduced from 64.3 per cent to 23.0 per cent from one year to the next and, in-

Table 3—Neonatal Mortality Rates for Single Live Births by Birth Weight, by Duration of Pregnancy and by Ethnic Groups—New York City, 1958-1961

| Birth Weight (grams) | Duration of Pregnancy (Weeks) | | | | | | | | | | | | | Total |
|-------------------------|-------------------------------|-------|-------|-------|-------|-------|--------|-------|-------|-------|--------|-------|----------------|-------|
| | Under 20 | 20-25 | 26-27 | 28-29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37-39 | 40 and Over | |
| White | | | | | | | | | | | | | | |
| Under 1,001 | 993.7 | 977.5 | 899.8 | 794.9 | 750.0 | 848.5 | 933.3 | 733.3 | 923.1 | 666.7 | 875.0 | 586.2 | 483.9 | 916.7 |
| 1,001-1,500 | 500.0 | 650.3 | 698.4 | 547.7 | 379.2 | 445.2 | 409.4 | 456.3 | 390.2 | 339.2 | 318.8 | 364.4 | 370.4 | 493.5 |
| 1,501-2,000 | 571.4 | 303.0 | 233.6 | 353.7 | 370.4 | 327.1 | 205.5 | 173.1 | 152.8 | 107.4 | 103.6 | 118.8 | 154.0 | 188.9 |
| 2,001-2,500 | 166.7 | 156.9 | 58.8 | 104.5 | 86.0 | 126.4 | 119.9 | 86.3 | 59.8 | 39.2 | 31.1 | 22.2 | 28.1 | 35.4 |
| 2,501-3,000 | 0 | 116.9 | 24.7 | 37.6 | 27.8 | 31.2 | 23.2 | 19.3 | 20.5 | 22.2 | 12.2 | 5.9 | 7.5 | 8.0 |
| 3,001-3,500 | 250.0 | 37.5 | 38.1 | 28.7 | 4.1 | 15.2 | 23.0 | 8.0 | 10.1 | 9.0 | 5.6 | 3.5 | 3.9 | 4.0 |
| 3,501-4,000 | 0 | 45.5 | 157.9 | 14.5 | 20.4 | 8.8 | 0 | 7.6 | 11.4 | 10.2 | 6.7 | 3.1 | 3.9 | 3.8 |
| 4,001-4,500 | 0 | 0 | 0 | 111.1 | 0 | 35.7 | 0 | 0 | 24.1 | 16.5 | 18.9 | 6.4 | 4.2 | 5.1 |
| 4,501-5,000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 95.2 | 22.2 | 11.3 | 3.3 | 5.5 |
| 5,001 and over | 0 | 0 | 0 | 0 | 0 | 500.0 | 1000.0 | 0 | 0 | 166.7 | 0 | 27.5 | 24.1 | 31.4 |
| Total | 792.8 | 745.2 | 549.8 | 349.9 | 191.0 | 177.0 | 112.2 | 70.9 | 44.5 | 27.1 | 16.9 | 6.1 | 5.5 | 13.7 |
| Nonwhite | | | | | | | | | | | | | | |
| Under 1,001 | 924.0 | 922.9 | 826.6 | 761.9 | 736.8 | 640.0 | 636.4 | 666.7 | 538.5 | 500.0 | 1000.0 | 666.7 | 666.7 | 868.8 |
| 1,001-1,500 | 607.1 | 535.9 | 509.5 | 443.2 | 266.0 | 324.1 | 380.4 | 237.5 | 190.5 | 152.2 | 171.4 | 300.0 | 275.0 | 379.5 |
| 1,501-2,000 | 312.5 | 223.3 | 153.2 | 185.0 | 206.9 | 163.5 | 100.8 | 118.4 | 89.7 | 88.1 | 76.9 | 71.4 | 103.4 | 119.7 |
| 2,001-2,500 | 0 | 92.1 | 33.7 | 52.0 | 55.9 | 26.8 | 29.2 | 24.8 | 24.8 | 29.2 | 17.6 | 15.5 | 24.2 | 22.2 |
| 2,501-3,000 | 0 | 10.3 | 11.0 | 23.4 | 11.0 | 7.4 | 12.2 | 20.3 | 10.0 | 6.6 | 10.3 | 5.9 | 7.9 | 7.5 |
| 3,001-3,500 | 333.3 | 54.8 | 32.8 | 16.1 | 20.7 | 5.5 | 9.5 | 2.0 | 8.2 | 9.6 | 6.5 | 5.5 | 4.5 | 5.5 |
| 3,501-4,000 | 500.0 | 90.9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 11.5 | 8.8 | 3.8 | 6.2 | 5.5 |
| 4,001-4,500 | 0 | 0 | 200.0 | 333.3 | 0 | 0 | 0 | 0 | 0 | 0 | 32.3 | 10.4 | 7.6 | 9.2 |
| 4,501-5,000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 13.1 | 14.6 | 13.4 |
| 5,001 and over | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 90.9 | 61.9 |
| Total | 783.5 | 652.2 | 412.3 | 247.2 | 138.9 | 100.9 | 59.5 | 43.7 | 25.1 | 19.4 | 14.4 | 7.7 | 7.9 | 25.6 |

Note: Neonatal mortality rate=Number of neonatal deaths under 28 days per 1,000 live births.

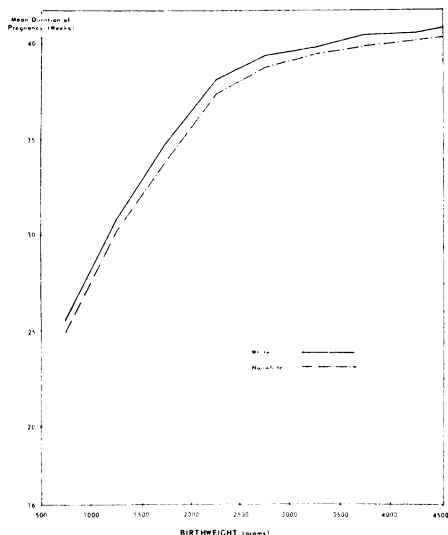


Figure 4—Mean Duration of Pregnancy by Birth Weight and by Ethnic Groups for Single Live Births: New York City, 1958-1961

stead of a curve with a single spike at 40 weeks, a curve approaching the normal resulted. Moreover, former accumulations at even weeks of gestation have disappeared.

Distributions by Duration of Pregnancy

Curves showing these gestation distributions of live births, by ethnic group, for various weight intervals up to 4,500 grams are presented in Figure 1. Because data for individual weeks were not available for the period under study, the distributions of live births in 1962 were used to estimate the numbers within the groups of less than 30 weeks and more than 36 weeks gestation for 1958-1961.

The configurations in these Figures are not surprising. The displacement of the curves to the right for successive weight intervals and the general shapes of the curves conform to expectations. The extreme skewness in the direction

of lengthy gestation for the two lowest weight groups may suggest some error in either the weight or gestation information. On the other hand, the marked similarity of the curves for the two ethnic groups favors credibility. Moreover, it suggests that any errors that might produce bias are of the same nature in both groups and that gestation comparisons will be valid. It cannot be said whether the extent of recall failure regarding the LMP date differs between the ethnic groups although it is known that larger proportions of nonwhites receive late or no prenatal care and, therefore, have a somewhat longer recall period than whites. Whether this factor biases the distributions will be further investigated.

In general, the nonwhite distributions as here depicted tend toward lower gestation intervals. This tendency is borne out by the mean values as will be subsequently shown.

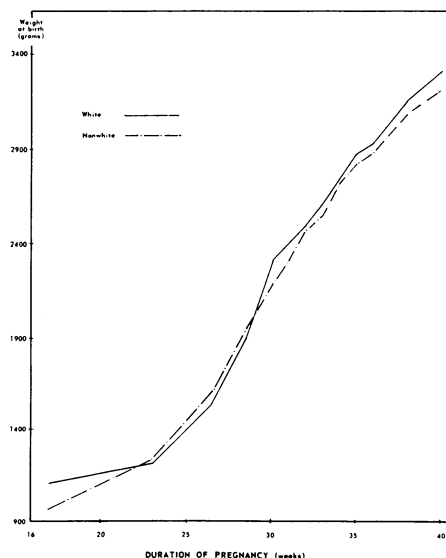


Figure 5—Mean Birth Weight by Duration of Pregnancy and by Ethnic Groups for Single Live Births: New York City, 1958-1961

Perinatal Mortality

Table 2 presents perinatal mortality rates per 1,000 deliveries by gestation and by weight for each ethnic group. In this discussion perinatal mortality comprises pregnancies terminating at

20 weeks or more gestation and resulting in either a fetal death or a neonatal death within 28 days after birth. Marginal rates indicate, for each ethnic group, diminishing loss rates with advancing gestation, except for a slight rise among nonwhites at 40 weeks or more

Table 4—Mean Duration of Pregnancy of Single Live Births by Birth Weight and by Ethnic Groups—New York City, 1958-1961

| Birth Weight (grams) | White | | | Nonwhite | | |
|-------------------------|-------|------|------|----------|------|------|
| | Mean | S.D. | C.V. | Mean | S.D. | C.V. |
| Total | 39.8 | 2.4 | 6.0 | 38.8 | 3.3 | 8.5 |
| Under 1,001 | 25.6 | 4.7 | 18.4 | 24.9 | 4.6 | 18.5 |
| 1,001-1,500 | 30.8 | 4.4 | 14.3 | 30.2 | 4.4 | 14.6 |
| 1,501-2,000 | 34.8 | 4.0 | 11.5 | 33.9 | 4.2 | 12.4 |
| 2,001-2,500 | 38.1 | 2.9 | 7.6 | 37.3 | 3.4 | 9.1 |
| 2,501-3,000 | 39.4 | 2.1 | 5.3 | 38.8 | 2.6 | 6.7 |
| 3,001-3,500 | 39.8 | 2.2 | 5.5 | 39.5 | 2.3 | 5.8 |
| 3,501-4,000 | 40.4 | 1.6 | 4.0 | 39.9 | 2.1 | 5.3 |
| 4,001-4,500 | 40.7 | 1.5 | 3.7 | 40.2 | 2.0 | 5.0 |
| 4,501-5,000 | 40.9 | 1.4 | 3.4 | 40.4 | 1.8 | 4.5 |
| 5,001 and over | 40.6 | 1.8 | 4.4 | 40.4 | 1.7 | 4.2 |

Note: C.V.=Coefficient of variation.
S.D.=Standard deviation.

Table 5—Mean Birth Weight of Single Live Births by Duration of Pregnancy and by Ethnic Groups—New York City, 1958-1961

| Duration of Pregnancy (Weeks) | White | | | Nonwhite | | |
|-------------------------------------|-------|------|------|----------|------|------|
| | Mean | S.D. | C.V. | Mean | S.D. | C.V. |
| Total | 3,215 | 553 | 17.2 | 3,045 | 775 | 25.5 |
| Under 20 | 1,105 | 875 | 79.1 | 970 | 675 | 69.6 |
| 20-25 | 1,210 | 955 | 78.7 | 1,240 | 895 | 72.2 |
| 26-27 | 1,545 | 980 | 63.4 | 1,615 | 950 | 58.8 |
| 28-29 | 1,900 | 901 | 47.4 | 1,955 | 845 | 43.2 |
| 30 | 2,305 | 858 | 37.2 | 2,195 | 800 | 36.4 |
| 31 | 2,410 | 808 | 33.4 | 2,310 | 755 | 32.7 |
| 32 | 2,500 | 728 | 29.1 | 2,480 | 695 | 28.0 |
| 33 | 2,630 | 664 | 25.2 | 2,570 | 650 | 25.3 |
| 34 | 2,760 | 615 | 22.3 | 2,725 | 620 | 22.8 |
| 35 | 2,885 | 583 | 20.2 | 2,820 | 580 | 20.6 |
| 36 | 2,945 | 550 | 18.6 | 2,875 | 540 | 18.8 |
| 37-39 | 3,185 | 472 | 14.8 | 3,080 | 480 | 15.6 |
| 40 and over | 3,395 | 488 | 14.4 | 3,255 | 495 | 15.3 |

Note: C.V.=Coefficient of variation.
S.D.=Standard deviation.

gestation (upper lines, Figure 2). Lower mortality is also observed among nonwhites than among whites at each gestation interval until about the 37th week. With weight at birth (upper lines, Figure 3), the rates decline regularly among both whites and nonwhites to a minimum and rise thereafter. The minimum rate occurs among whites (7.6 per 1,000 deliveries), at 3,001-3,500 and 3,501-4,000 grams, but among nonwhites (10.0 per 1,000) at the 3,001-3,500 weight only. Mortality among nonwhites was found to be consistently lower than that among whites until about 3,000 grams; beyond 3,000 grams the situation reversed.

From the perinatal loss rates among the cases of unknown weight or gestation, it appears that they are highly biased toward low weight-early gestation intervals. Consequently, loss rates at these intervals are subject to some error. Such an eventuality, however, seems unlikely to affect substantially the general patterns shown in this paper or the conclusions.

In general, loss rates tend to decline with advancing gestation regardless of weight at birth until term. Other studies have shown rising mortality after 40 weeks and these data suggest that such rises are not affected by weight of the infant except possibly at the ends of the weight scale. Unfortunately, our data are not sufficiently detailed at the upper end of the gestation scale to reach any definitive conclusions on this point. With birth weight the tendency is for declining mortality with increasing weight to about 3,000 grams with rises occurring thereafter. These observations indicate a nonlinear relationship between the variables.

Neonatal Mortality

The remainder of this paper is concerned mainly with neonatal mortality which reflects the perinatal loss picture

but has less frailty because of the relatively smaller proportions of unknown birth weights.

Table 3 provides neonatal death rates for each ethnic group, which are shown as the lower lines in Figures 2 and 3. The patterns are so similar to those for perinatal mortality that there is no point to a lengthy discussion of the gross patterns. However, it is worth while to comment on the explanation generally offered for relatively lower neonatal mortality at lower gestation or lower birth weights among nonwhites as compared to whites; namely, that the fetal death rates at these gestations or weights may be higher among nonwhites than whites. A review of fetal death rates (which are not presented here) indicates clearly that the lower neonatal mortality among nonwhites is not explained by any excess of fetal deaths. In fact, the fetal death rates for low gestations and low birth weights are also smaller among nonwhites than among whites. This fact is reflected in the similar relationships between the two ethnic groups for both neonatal and perinatal rates.

The mean gestations at specific weight intervals and the mean birth weights at specific gestation intervals for live births by ethnic groups are shown in Figures 4 and 5. The data are presented in Tables 4 and 5, together with the standard deviations and coefficients of variation. In keeping with the observations already made about the distributions of live births, it is not surprising to find that nonwhites, at every weight group, have a shorter duration of gestation than do whites. On the other hand, nonwhites tend to be slightly heavier, on the average, when delivered at less than 30 weeks gestation.

It is a matter of interest that the variability in duration of gestation, as indicated by the coefficients of variation, are of similar magnitudes for both ethnic groups and that the variability decreases with advancing birth weight.

Similar observations hold for variability in birth weight. However, weight varies to a markedly greater extent than does gestation.

Admittedly, these data are difficult to interpret. They suggest that the explanation of the reversal in infant loss rates at a birth weight just above 2,500 grams is not based on greater maturity among the nonwhites at lower weights, at least as measured by duration of gestation, since nonwhites prove to be delivered at a younger gestational age than are whites at all weights.

The relationships shown in Figures 2 and 3 are generally reflected in each

specific gestation interval and for each specific weight interval; namely, that nonwhite experience is the more favorable at earlier gestations and at lower weights. For weight, the reversal in this pattern occurs between the 2,501-3,000 birth weight interval, where the loss rates are 8.0 and 7.5 for whites and nonwhites respectively, and the 3,001-3,500 interval, where the rates are 4.0 and 5.5. Let us, therefore, examine the loss rates by gestation within these weight intervals. Figures 6 and 7 show the patterns, to which we can add comment from observations already made.

Within the 2,501-3,000 gram group,

Figure 6A—Neonatal Mortality Rates Among Single Live Births of Birth Weight 2,501-3,000 Grams by Duration of Pregnancy and by Ethnic Groups: New York City, 1958-1961

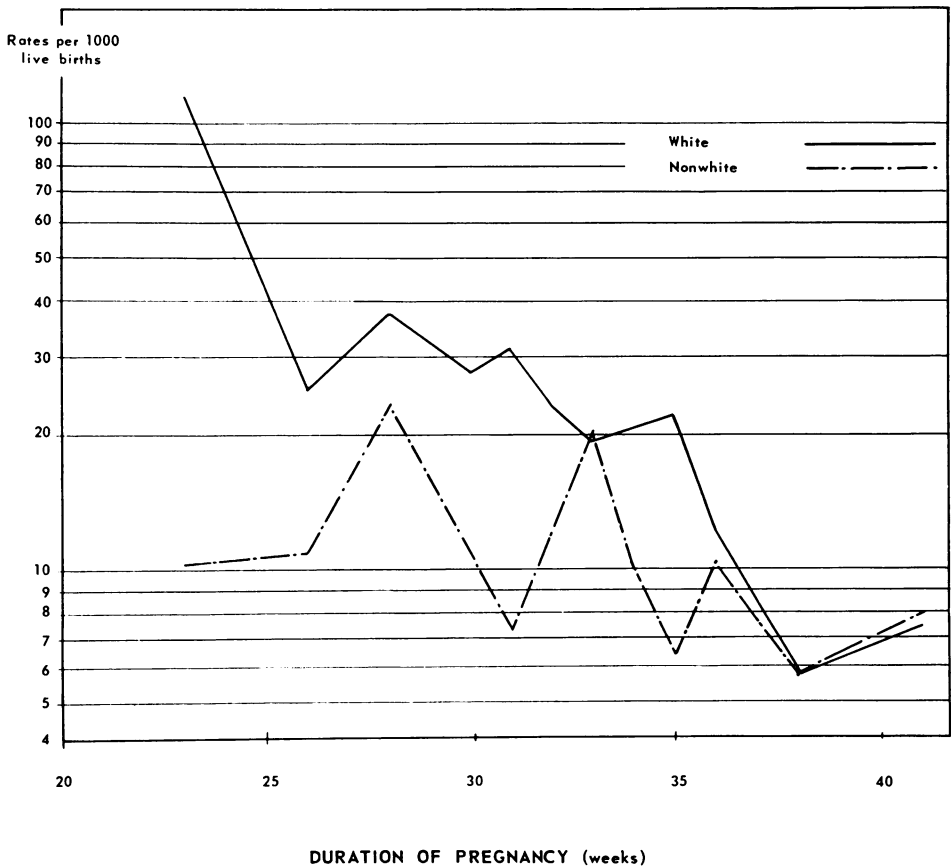
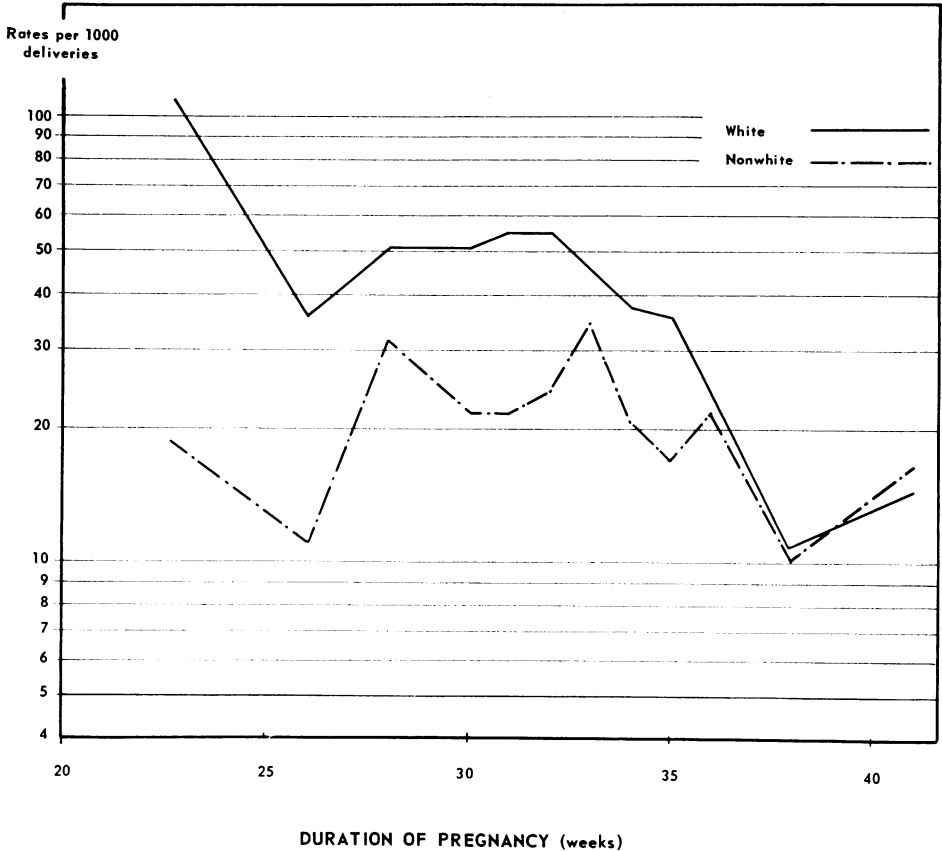


Figure 6B—Perinatal Mortality Rates Among Single Deliveries of Birth Weight 2,501-3,000 Grams by Duration of Pregnancy and by Ethnic Groups: New York City, 1958-1961



gestation-specific neonatal mortality rates (Figure 6A) are generally lower for the nonwhites, except for a few points where the rates approximate each other. The question might validly be raised that higher fetal loss rates among nonwhites at the earlier gestational ages could account for this finding, but inclusion of fetal losses in perinatal mortality rates (Figure 6B) serves but to emphasize the gestation-specific differences. The disparity in the gross rates, however, is narrowed to 14.9 and 14.4. As noted previously, the mean gestation for live births is lower among the nonwhites and their distribution tends toward lower gestation intervals.

Within the 3,001-3,500 gram group, gestation-specific neonatal mortality rates (Figure 7A) among nonwhites are again generally lower than among whites, but nonwhites rates exceed those of whites after the 34th week of gestation. Moreover, not alone do the excess nonwhite rates start at an earlier gestational age than in the previous weight interval, but the difference between the rates is more marked at the later gestations. Here again, inclusion of fetal losses in the perinatal rate (Figure 7B) clarifies the picture but does not materially change it, although the crossover in loss rates does occur at a later gestation. Mean gestation is also lower among the

nonwhites in this weight interval and the distribution of live births also shows a shift toward lower gestation.

Discussion

It seems incontrovertible that non-white infants experience a better survival at low birth weights than do white infants, whether survival be measured by neonatal or perinatal rates. To this

extent, the present paper merely confirms earlier observations. We have been able to show, in addition, that with weight held constant the experience of the nonwhites is better than that of the whites until late in pregnancy. The better survival of nonwhites at the lower weights does not, therefore, seem to be a function of their more advanced maturity, at least insofar as maturity is measured by duration of gestation. The

Figure 7A—Neonatal Mortality Rates Among Single Live Births of Birth Weight 3,001-3,500 Grams by Duration of Pregnancy and by Ethnic Groups: New York City, 1958-1961

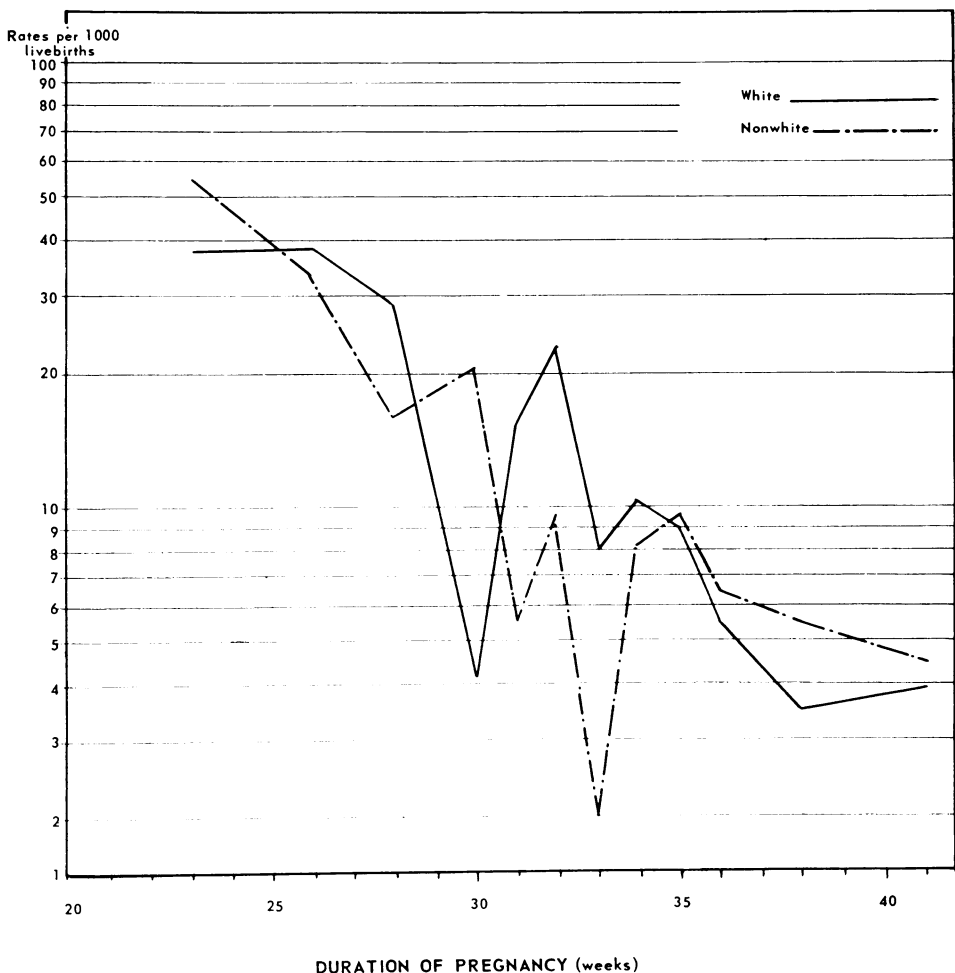
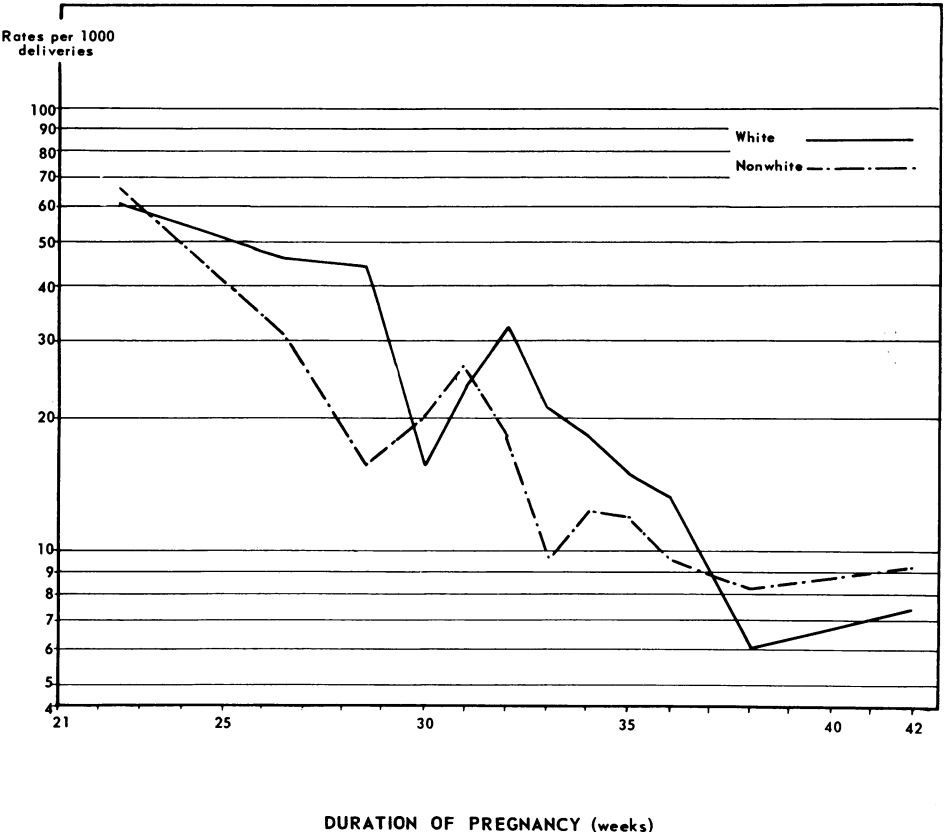


Figure 7B—Perinatal Mortality Rates Among Single Deliveries of Birth Weight 3,001-3,500 Grams by Duration of Pregnancy and by Ethnic Groups: New York City, 1958-1961



differences in gross rates, neonatal and perinatal, between whites and nonwhites appear to be a function of the distributions at delivery. The better experience of the nonwhites at low weights and at earlier gestations is overcome by their poorer experience at high weights and advanced gestation, where greater proportions of deliveries occur.

This explanation, of course, still leaves many questions unanswered. Why do nonwhites have a relatively better survival than whites if delivery occurs well before term, when the infant or fetus can be expected to be light in weight? Why, conversely, should the nonwhites have poorer survival late in pregnancy,

when birth weight may be expected to be higher? Why do nonwhites have relatively heavier babies than whites at earlier gestations? Basically, do the nonwhites in fact mature faster than whites in utero in a physiological development that is not equivalently measured in the two groups by either birth weight or duration of pregnancy? If so, does this mean that the relatively poor experience of the nonwhites late in pregnancy indicates undue prolongation of the pregnancy for them? Or do these data mean that nonwhites are inherently more rugged, able to withstand more deprivation during early months of gestation and the rigors of an early delivery,

whereas the full toll of such deprivation is felt mainly by those who struggle through to term? Is it possible that poor risks are discarded earlier in pregnancy in the form of spontaneous abortions among the nonwhites and that the survivors to the middle of the second trimester are, hence, more capable of surviving against odds than whites who may be nurtured more carefully during the early months of pregnancy?

It seems to us, from the data presented here, that there are basic differences between the two ethnic groups regarding the birth weight-gestation structures of the populations of deliveries as well as with respect to neonatal and perinatal mortalities. To some extent, differences in crude mortality rates derive from the different birth weight-gestation structures. Relative durations of pregnancy do not, however, explain the differences in weight-specific mortality. We believe that neither birth weight nor gestation alone can adequately be used to measure maturity at delivery in both populations using the same standard, as is presently practiced.

More knowledge about the development of a fetus in utero is essential. A comparison of these developmental stages by birth weight and gestation is needed to determine whether infants of one ethnic group mature either at earlier gestation or at lower weight. Such studies would then perhaps indicate the appropriate scale for maturity for each ethnic group, using birth weight and gestation either singly or in combination or with some third variable that such research may reveal.

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Summary

We have presented an analysis of perinatal and neonatal losses by gestation, birth weight, and ethnic group among almost 650,000 deliveries in New York City from 1958 to 1961.

Both perinatal and neonatal loss rates are, in general, lower among nonwhites than among whites at weights less than 3,000 grams and gestations less than 35 weeks.

The patterns of loss among both whites and nonwhites are similar, declining to a minimum and increasing thereafter, whether perinatal or neonatal loss alone is considered.

Nonwhites have lower mean duration of pregnancy than whites for each birth weight interval. However, nonwhites weigh more on the average than do whites at gestations below 30 weeks, but weigh less at 30 weeks or more.

The lower neonatal loss rates among nonwhites at low birth weights does not appear to be a function of longer duration of pregnancy.

Research is needed in the comparative development of fetuses of different ethnic groups to determine whether, in fact, there is a difference in their rates of development.

REFERENCES

1. Schlesinger, Edward R., and Allaway, Norman C. The Combined Effect of Birth Weight and Length of Gestation on Neonatal Mortality Among Single Premature Births. *Pediatrics* 15:698-704 (June), 1955.
2. Steiner, Morris, and Pomerance, William. Studies on Prematurity II. Influence of Fetal Maturity on Fatality Rate. *Ibid.* 6:872-877 (Dec.), 1950.
3. Taback, Matthew. Birth Weight and Length of Gestation with Relation to Prematurity. *J.A.M.A.* 146: 897-901 (July 7), 1951, and *Periatrics* 32:793, 1963.